Summary

This case study outlines the approach taken by DONG Energy to establish a helicopter crew transfer system to support operations and maintenance (O&M) at the Westermost Rough Offshore Wind Farm, and shares DONG’s early experiences and lessons learned.

Key Findings

- The availability of a helicopter is key for troubleshooting, particularly when performing turbine resets and addressing minor defects. DONG also intends to use the helicopter for planned service tasks and for exchanging larger components, such as converters and the roof-mounted passive cooler.
- An engagement plan focused on the use of helicopters was developed to help build confidence among operational staff, including technicians. A phased training approach was deployed to support the plan.
- Securing an appropriate O&M base with proximity to helicopter facilities is considered a game-changer, and this is one of DONG’s key objectives. However, it is not always possible to locate a helicopter base adjacent to a wind farm’s onshore O&M base due to planning or land restrictions.
- DONG believes that the helicopter operations at Westermost Rough will deliver valuable learning for future projects which are further offshore – including the new Race Bank and Hornsea One sites.

Recommendations

To ensure the safe and effective use of helicopters at Westermost Rough, key success factors included:

- The deployment of a robust implementation plan, which ensured that technicians became familiar with helicopter operations. Staggering the rollout of helicopter transfers helped to build confidence.
- Tracing key performance metrics to optimise usage.
- Integration of helicopter and Crew Transfer Vessel (CTV) marine coordination.
- The creation of a detailed helicopter manual document to outline requirements and processes, and ensuring that dangerous goods packing is incorporated into work planning and helicopter coordination procedures.
- Provision of sufficient storage at the airport base for personal protective equipment (PPE).
- Delivery of essential, effective training, and close collaboration with the helicopter provider to ensure that refresher training is carried out efficiently.
Introduction

A key consideration for any offshore wind farm is the choice of a logistics solution. There are many options available, including crew transfer vessels (CTVs), offshore accommodation, service vessels and helicopters.

Most operational wind farms deploy CTVs, which transport workers to the wind farm each day from a local port. In the UK, this is a tried and tested methodology across Round 1 and Round 2 offshore wind farms.

As wind farms increase in size and move further offshore, new logistics solutions are required. While alternative solutions may deliver strategic advantages, adopting new approaches could also force changes in the way operations and maintenance (O&M) services are delivered. To date, there is relatively little experience in the deployment of novel logistics solutions for others to draw upon.

Helicopters offer benefits in that they reduce transit times and introduce the potential to work in higher sea states than CTVs currently allow. However, in order to maximise the value they offer, it is important to understand the different regulatory requirements and the new set of constraints which govern their operations. Experience of helicopters in the field is limited to a handful of projects; costs and operational limitations vary depending on the type of helicopter used and other site-specific factors.

This makes it challenging for future projects to assess their costs and benefits and as the deployment of alternative strategies widens, this is seen as an important area for knowledge sharing.

Figure 1: Westermost Rough Offshore Wind Farm: key facts and figures.

Westermost Rough Offshore Wind Farm is a joint venture between DONG Energy, Marubeni Corporation and the Green Investment Bank, and the first commercial wind farm to deploy 6MW direct drive turbines. Located 8km from the Yorkshire coast north of Hull, the wind farm is operated from a service base at Grimsby, where the journey time by CTV is around 90 minutes. DONG
provides and manages an O&M operations base located in the Royal Dock at Grimsby. As part of the O&M strategy for Westermost Rough, DONG is responsible for providing transportation to the wind farm for its staff and for contractors that support the site. DONG has elected to include a helicopter to support offshore transfers, in addition to several CTVs.

This case study outlines the approach taken by DONG Energy to establish helicopter operations to support O&M at the Westermost Rough Offshore Wind Farm, sharing DONG’s early experiences and lessons learned.

The challenge

As wind farms are built further from suitable ports, the logistical challenges around O&M become more complex. Longer CTV journeys reduce the amount of time that offshore workers have to undertake maintenance work in a given day. Compounding this, the impact of poor weather extends the time taken to repair turbines. Longer journeys also make it more difficult to respond quickly to short weather windows to carry out necessary turbine repairs.

Westermost Rough uses some of the largest turbines currently deployed in the UK, and any unplanned downtime results in a higher level of lost revenue than earlier projects. DONG is therefore looking for a logistics solution that offers flexibility and the potential to react quickly to unplanned downtime events. Fast repairs necessitate a fast response, and the ability to deploy fault-finding technicians and deliver spare parts and tools to the turbine is crucial.

The deployment of CTVs can be restricted by rougher sea states and teams can be delayed in accessing turbines. While helicopters can transfer crews in higher sea states, their use can be limited by periods of low visibility. There are also limits around working within the turbine nacelle, as these are generally lower than the winching limits for a helicopter.

A summary of different access concepts is shown in Table 1, below. While helicopters are unlikely to completely replace CTVs at a site like Westermost Rough, DONG has chosen to supplement CTVs with a single helicopter operating from a local airport.

Strict rules and regulations apply to the use of helicopters in an offshore environment, especially in situations where technicians are winched on to a turbine. These rules state that all flights must:

- be undertaken during daylight
- carry additional navigation and safety equipment
- carefully assess fuel requirements, impacting the total weight that can be carried to the turbine.

The weight of individuals, tools and spares is restricted when using a helicopter, which means the maintenance work that can be undertaken must be carefully coordinated with the helicopter provider and the wind turbine Original Equipment Manufacturer (OEM).
**Logistics solution** | **Key features, advantages and constraints**
---|---
**Crew Transfer Vessel** | - Well-proven and relatively low-cost.  
- Space for a wide range of tools and spare parts.  
- Current transfer limit is typically waves 1.75m Hs.  
- Long journey time for some Round 2 and Round 3 projects.
Typically 16 – 25m catamaran, purpose-designed and carrying up to 12 people.  
**Helicopter** | - Potential to reduce transit time to far offshore sites.  
- Can transfer in higher sea states than CTVs.  
- Higher cost than CTVs.  
- Limited space/weight limit for spare parts and tools.  
- Helicopter platform required on roof of nacelle.  
- Only limited operational experience. Is currently in use at several sites, so performance data is accumulating.  
Helicopter with offshore specification. Turbine dimensions dictate maximum size of helicopter.  
**SOV (Service Operation Vessel)** | - Travel time to wind turbines greatly reduced.  
- Weather windows can be exploited more readily.  
- Higher cost than CTVs.  
- Only suitable for deeper sites.  
- Relatively unproven, but being adopted at a number of new sites so performance data is accumulating.  
A large, all-purpose vessel with accommodation, storage for spare parts and tools, transfer method and often a helideck. Technicians stay aboard for periods of up to two weeks.  
**Offshore Accomodation Platform** | - Travel time to wind turbines greatly reduced.  
- Short weather windows can be exploited more readily.  
- Higher capital costs and ongoing costs to maintain and manage the facility.  
- Little use to date, so very little operational experience.  
A fixed accommodation platform with storage for spare parts and tools and often a helideck. Crew stays offshore for periods of up to two weeks.  

*Table 1: Comparison of logistics solutions*
How are helicopters regulated for use at offshore wind farms?

Aviation is regulated internationally by the International Civil Aviation Organisation (ICAO) and the European Aviation Safety Agency (EASA). In the UK, the Civil Aviation Authority (CAA) directly or indirectly regulates all aspects of aviation operations, and it can also implement additional “national” standards to those required by ICAO and EASA.

Helicopter operations to transfer technicians directly to offshore wind turbines are governed by stringent and specific safety requirements, and the regulation of the onshore and offshore elements of this logistics operation is complex. In accordance with the DECC Aviation Plan, the offshore wind sector has produced an Offshore Renewables Aviation Guidance (ORAG) document to provide a framework approach to developing a robust aviation policy and safe operations strategies for aviation support. The guidelines include good practice for the use of helicopters – mainly during the construction and O&M phases of an offshore wind farm.

The ORAG has been produced by a Project Steering Group comprising RenewableUK members with expertise in offshore aviation operations, offshore Health and Safety and risk management, offshore development, and offshore operations. As part of the process, the group consulted with regulators and air operators, and offshore renewables developers, operators, and wind turbine original equipment manufacturers, through the broader Offshore Renewables Aviation Forum (ORAF), which is co-chaired by The Crown Estate and RenewableUK.

The aviation support strategy developed using the ORAG can include, for example, heli-hoist operations, underslung loads and medical transport, all of which are relevant to the use of helicopters for logistics support at operational wind farms. If needed, the guidance also includes information relating to helicopter-based inspections. The ORAG is available as a hard copy or from the RenewableUK website. It covers:

- Aviation safety and risk management
- Overview of the regulatory requirements
- Requirements for the design of turbines
- Selection of aircraft
- Operational management and control considerations
- Personnel competence
- Procurement and contract management considerations.

As part of the good practice outlined in the document, it is recommended that specialist support is sought to ensure interfaces are well managed, including onshore base requirements, aircraft selection and contracting strategy. There are a number of annexes and references in the ORAG to provide guidance on these specialist areas.

An example of interface management requirements between turbine design and aircraft selection is shown. This has been taken from the CAA guidance publication CAP 437 – Standards for Offshore Helicopter Landing Areas, which was produced to set minimum requirements for helicopter winching areas at offshore wind farms. There are also specific requirements regarding the transport of dangerous substances, and for emergency planning. The regulation of helicopter operations at offshore wind farms is an evolving area, subject to future review and change as the use of helicopters widens.
While the use of helicopters remains limited, there are two main approaches to deploying them at a wind farm site. These are shown in Figure 2. In the first scenario, a helideck (usually on the offshore substation platform) is used as a “staging post” to deploy several teams of technicians. This is more common for projects that are further offshore, and there is often a store of spare parts held on the offshore platform. In the second scenario, helicopter operations are managed from a shore base; the helicopter travels directly to the turbine with a single team of technicians onboard. An offshore wind helicopter strategy must consider the rules and restrictions governing the safe operation of helicopters in the offshore environment. A suitable base must be established – either at the wind farm, an O&M port, or at a local airport. Each helicopter operation must be assessed to determine how much cargo can be accepted, so logistics and maintenance planning procedures must be adapted specifically.

The approach

Although this was DONG’s first deployment of a helicopter in the UK, they had been used previously at Horns Rev 1 Offshore Wind Farm in Denmark. DONG holds a 40% stake in the project, and helicopters have been part of the logistics mix there since 2002. The team at Westermost Rough was keen to learn from the Horns Rev 1 team’s experiences while ensuring that helicopter operations were undertaken safely and in an integrated way.

Arrangements for the use of helicopters at Westermost Rough

At Westermost Rough, DONG provides CTVs and a helicopter to enable technicians to access the offshore turbines. The helicopter contract is with Unifly, a firm with experience of helicopter operations across northern Europe. It is the first contract placed by DONG for aerial support, and the first time Unifly have operated a helicopter, at an offshore wind farm in the UK.

DONG believes that there is an advantage in contracting directly with logistics providers for both CTVs and the helicopter. This strategy enables each site to deploy the same logistics approach for
turbine and balance of plant work, and improvements can be easily identified and implemented.

The helicopter is based at Humberside airport, a 30 minute drive from the O&M base in Grimsby. Unifly liaises with the airport, where other helicopter operators are engaged in providing helicopter transit services for the offshore oil and gas sector and for UK search and rescue services. Unifly uses an Airbus Helicopters H135 (formerly known as the Eurocopter EC135), which was built specifically to service this contract.

A hangar is provided at the airport to house the aircraft, along with fuel and fire-fighting provision. DONG has equipped a small storage area to hold flight suits and other personal protective equipment (PPE) and provided an area to undertake pre-flight briefings. Technicians transit from the O&M base to the airport by road and go through a robust check-in procedure prior to take-off.

DONG is also responsible for overseeing the operation of the helicopter, supported by Unifly. DONG has a dedicated logistics team which works closely with the O&M team at the Westermost Rough site. The helicopter is made available to the turbine OEM to support the maintenance services they provide under the service and warranty contract.

To ensure safe and effective procedures were in place, DONG developed a Helicopter Operations Manual outlining the regulations that govern the use of helicopters in offshore wind. This detailed document pulls together regulatory requirements from the CAA and others and incorporates them into a set of procedures, into which maintenance considerations are integrated.

It is recommended that operators align with generic helicopter guidelines so they can support each other in delivering best practice in safe operations.

DONG has considered the potential activities that could be supported by the on-site helicopter. While the main benefits are expected to be the ability to perform manual turbine resets, initial fault-finding and troubleshooting, it plans to use the helicopter for a wide range of tasks. DONG has identified the potential to use the helicopter for bigger repairs, including exchanging large components such as converter modules. It will be used to perform maintenance on a passive cooling unit which is located on the roof of the nacelle, which would otherwise require a jack-up vessel to facilitate its exchange. Additionally, there is the potential to use the helicopter to support planned maintenance work during the service campaign, improving the potential for the turbine OEM to deliver this work on schedule.

The operations manual also covers the transportation of items that are identified as dangerous goods under their legal definition. It identifies the controls required to make sure these can be transported offshore safely. A dedicated area of the warehouse has been set up to manage the packaging and transportation of items defined as dangerous goods.
Getting the team on board and building confidence

Unlike for oil and gas workers, where helicopters are often used for transfers and take-off and landing takes place on a fixed platform, wind farm workers are winched from the helicopter to the turbine. A specially designed “basket” is fitted to the top of the turbine nacelle to provide a safe area for winching operations. Controls are in place to ensure the turbine remains in a safe position during helicopter operations and safety indication lights are used to provide information to the helicopter pilot. The onshore marine control centre closely monitors all hoisting activities in real time and provides advice and support as needed. Spare parts and tools required for maintenance tasks are also transported in the helicopter (subject to weight restrictions) and winched on to the turbine.

Figure 3: Westermost Rough’s Helicopter

DONG acknowledged early on in the planning of helicopter operations that people transiting between the shore and the wind farm can be apprehensive and may have concerns and questions. Early in the process, the O&M team put together a programme of work to familiarise their team members and key contractors with the helicopter transfer procedure in a staged way, which included:

- Initial talks and film footage from technicians who had already transferred to turbines using a helicopter.
- A familiarisation tour of the aircraft.
- Safety training, including helicopter-focused marine survival training.
- Familiarisation flights in the helicopter.
- Introductory ground-based winching training – initially using lifting bags.
- Low-level winch training using the helicopter.
• Winch training at height.
• Winch training onto, and off of, the turbine.

The technicians in question were given the opportunity to ask questions and time was taken to introduce the processes gradually. Through this structured, focused approach, apprehensions were overcome and the team is now confident in transferring using the helicopter. There are also advantages for staff in using the helicopter to transfer to the wind turbine generators (WTGs), in that it reduces transfer times and instances of sea sickness are eliminated; many technicians now prefer to use the helicopter.

All staff must receive training prior to undertaking a winching operation on the wind farm. This training was delivered by Unifly in Denmark. CAA regulations require that anyone who has not winched for more than 90 days must undergo refresher training. Any new staff working at the site may also require helicopter training and DONG is working with the helicopter operator to ensure that ongoing and future training is delivered effectively.

Integrated marine and helicopter operations

DONG reviewed and adapted existing procedures for marine coordination to incorporate helicopter and vessel coordination. The site marine coordination team cover both vessel and helicopter coordination. It has also been necessary to adapt and extend some of the computerised systems to include helicopters. DONG has worked closely with Siemens Wind Power (SWP) to ensure the operation of the helicopter enables the OEM to deliver services effectively. Decisions about when and how to task the helicopter to provide transportation to the site is a cooperative and joint decision lead by a mixed DONG and SWP site team. The amount of cargo that can be safely carried by a helicopter must be calculated by the helicopter operator and will vary depending on weather conditions and the amount of fuel that the helicopter is required to carry. It has been necessary to ensure O&M team members have an appreciation of how this can impact on logistics decisions. The Unifly team works closely with the Westermost Rough team to assess each task and provide input into the planning and scheduling of helicopter transits, ensuring that the weight of technicians, tools and spare parts is considered.

The results

Helicopters have been in use for a relatively short time at Westermost Rough and the results presented here are taken from the first six months of deployment.

How have helicopters been used?

The helicopter has mainly been used to deploy technicians for troubleshooting faults and to carry out planned service tasks. Its first outing was on 15 June 2015 to support troubleshooting. Visits were made to 15 turbines in 2.5 days and the helicopter enabled a greater number of turbines to be visited than would have been possible with a CTV-only solution. The nature of this particular fault meant it
was not possible to use the turbine lift and the helicopter removed the need for technicians to climb the ladders. It was also used for VIP trips to the wind farm during its open day and on an ad-hoc basis, and it was used to deploy spare parts directly to the top of a turbine nacelle when there were early snagging issues related to the turbine crane.

Westermost Rough is currently working with the helicopter owner and the turbine OEM to identify further uses of the helicopter on the site. There have been occasions during the early operational period when the helicopter could not be used – for instance:

- Eight days of flying time were lost when the helicopter was damaged in the hangar.
- The helicopter was not used during periods of low visibility (largely due to fog).
- The helicopter was not used when the wind speed exceeded 20m/s at the nacelle height.
- The helicopter was not used as a result of ad-hoc events, including a bomb scare at the airport and following a bird strike on the helicopter.

DONG took seriously the requirement to manage dangerous goods, as defined in the CAA’s regulations. This has resulted in restrictions on certain stock items and all dangerous goods are checked and packaged appropriately. Every effort is made to ensure full awareness among the crew with regard to the types of dangerous goods being carried.
How is DONG deploying the helicopter at Westermost Rough?

The helicopter transfers a team of technicians from Humberside airport directly to a wind turbine and the technicians are winched onto a fenced area on the top of the nacelle. Spare parts are also lowered into the nacelle as needed. A lifting frame is available to lower spare parts and tools safely inside the nacelle. A lifting frame is provided on each turbine and requires assembly each time it is used. Two technicians are typically winched on to the turbine and procedures are in place to stop the turbine and fix the blades in to a specific configuration required for the safe approach of the helicopter. Once the personnel and equipment has been safely transferred, the helicopter returns to the airport to either collect another team or to wait until the initial team is ready to be picked up.

Specialist training is required before transiting by helicopter, which includes sea survival and techniques specific to the use of helicopters, such as winching operations. This training must be renewed periodically and winching is only permitted if personnel maintain familiarity. Refresher training is required if it has been longer than three months since personnel last undertook helicopter transfers.

What lessons have been learned from the early operational deployment of the helicopter at Westermost Rough?

Although the helicopter has only been in use for a relatively short period of time, key lessons learned are:

- Start planning early, and place paramount importance on understanding the CAA’s rules and how they affect operational decisions and practices.
- Be prepared to change conventional marine coordination and task planning processes to ensure that helicopters can be integrated, creating a single approach to logistics planning, coordination and
monitoring.

- Understand and plan for legal requirements arising from the need to transport dangerous goods.
- Build confidence within the team at an early stage, and take a step-by-step approach to training and early use.
- In situations where the heliport is remote from the O&M base, ensure there is sufficient space to store PPE required for helicopter transits. Prepare and use cargo pack lists in advance so that these can be assessed and used to optimise work.
- Consider using lifting bags that have been designed with helicopter winching in mind. At Westermost Rough, the team invested in offshore lifting bags with a different shape to enable them to be deployed more easily from the helicopter. An effective tagging system will ensure that the correct bags are deployed.
- Ensure the pilot’s operational hours are optimised and well-communicated – be clear when the pilot will be required to avoid wasting potential flying hours.
- Where possible, co-locate the heliport close to the O&M building to avoid transit delays and maximise working time offshore. At Westermost Rough, the helicopter flight time is around 12 minutes from Humberside airport, but transit between the O&M base and airport adds additional time. The total deployment time for the helicopter, including travel between the O&M base and airport, is approximately one hour, depending on traffic.

Key benefits

What benefits has the helicopter brought?

When the helicopter is deployed at Westermost Rough, it is possible for a single team of technicians to undertake multiple tasks on multiple turbines within the same working day. This reduces operating costs and increases turbine availability. The helicopter has enabled access on occasions when it was not possible to transfer using a CTV. This increased flexibility has reduced delays in the delivery of planned maintenance and annual services. As a result of snagging and other issues typically rolled on from the construction phase, some turbines could not be accessed using the service lift. Using the helicopter eliminated the need for technicians to climb the internal ladder to access the nacelle.

How will DONG continue to learn from their experiences at Westermost Rough?

The results presented in this case study show only a snapshot from the early operational experience which has been gained at Westermost Rough, but operations are ongoing and data and experience is being collected all the time. DONG will use this knowledge when developing O&M strategies for future offshore wind farms. The full benefits will only become clear as further evidence and experience accumulates over the long term. Westermost Rough is the first commercial deployment of a new turbine design incorporating direct drive technology and because of this, there is no established track record or experience of typical failure rates and the types of faults that require intervention.

While modelling will have been undertaken prior to agreeing the O&M strategy for this site, it is only after amassing operational experience that sufficient information will be available to undertake model
validation. This will enable a fuller assessment of the costs and benefits of helicopter use at Westermost Rough. Additionally, DONG has only recently established practices for the use of helicopters in the UK and these are being reviewed, adapted and improved as information and evidence is built up.

Once a steady implementation has been achieved, taking into account turbine performance experience and frequency of maintenance tasks, DONG will be able to better assess the preferred approach. It also hopes to use the Westermost Rough project to learn lessons that can be applied at future, larger, further afield offshore projects.
Appendices

Author profile

Sally Shenton is the Managing Director of the offshore wind O&M consultancy Generating Better. Prior to this, she held the position of Operations Manager for various offshore wind farms.

Contributor

Rob Sampson is the Head of Site Management at Westermost Rough and has worked in the wind industry for six years. Rob has been in post at Westermost Rough for two years and previously was Site Manager at the Lynn and Inner Dowsing and Lincs offshore wind farms.

About the O&M Case Studies series

This is one in a series of offshore wind O&M-focused case studies, supported by ORE Catapult’s O&M Forum and funded by The Crown Estate and the Offshore Wind Programme Board. These studies aim to highlight game-changing O&M projects and share knowledge among the offshore wind O&M community.

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